"Syringe block for automatic machine for analysis of liquids, in particular for blood analysis"

The present invention relates to a syringe block, in other words a set of several syringes, used in an automatic liquid analysis, in particular blood analysis, machine. It also relates to an automatic machine equipped with a syringe block of this kind.

Syringes are an essential element of an automatic analysis machine. They must function in a reliable manner, in particular as regards precise dosage of the liquids to be analyzed or the reactive liquids to be used in analysis. The same applies to the systems connected to the syringes, such as the tubing, the motor systems, the valves and the associated electronics. The risks of breakdown and various leaks which could either distort the analysis or render it impossible should thus be minimized. The realization costs and maintenance times and costs of these automatic machines should also be as low as possible.

With the aim of increasing the reliability of such automatic machines, it has in particular been proposed to reduce the number of motors controlling the movement of the syringes. Thus the document FR 2,815,719 proposes a common motor system for several syringes used for the dosage of the reagents.

However, automatic machines still have numerous disadvantages, in particular that of integrating numerous hydraulic and electric cables between different constituent elements, which entails a cost in particular for their assembly and for their maintenance. Thus, the materials which constitute the hydraulic tubing are particularly sensitive to ageing.

The aim of the invention is to suggest a device allowing the improvement of the reliability of an automatic analysis machine, while simultaneously reducing the assembly and maintenance costs.

According to the invention, such a device is a syringe block, in particular adapted to be used in an automatic liquid-sample analysis machine, said block comprising several syringes and a collector (also called manifold), each syringe comprising a casing and a piston which between themselves define an internal volume,

said collector containing electronic switch valves, first ducts linking the electronic switch valves direct to respective internal volumes, variations of which allow the displacement of fluids or liquids used for example by the automatic machine, and second ducts extending from the electronic switch valves to accessories, in particular in the direction of containers for the sample and/or other liquids. Thus, as the syringes are mounted directly on the collector, the hydraulic cabling is limited, and therefore in particular the risks of leaks.

The accessories can advantageously be linked direct to the electronic switch valves by the second ducts or tubing can extend the second ducts between the collector and the accessories.

Advantageously, the syringe block can also comprise an air pump. The air pump can comprise at least one, or more, syringes. This pump can in particular be provided to create a depression in a tank, in order to take a sample with a view to counting in an automatic analysis machine. It can also be provided for the removal by suction of waste, such as liquids which cannot be used, in particular if they have been used in an analysis which has now finished. This waste can also be a rinsing liquid which has been used. The air pump allows waste be sucked from tanks or chambers used for analysis, then disposed of in a dustbin.

The syringe block can comprise one or more parts in which the internal ducts are realized by moulding. Thus, these parts can be made from plastics. The ducts made in this way are in particular not very sensitive to ageing.

The air pump can comprise at least two syringes, operated simultaneously or not, which allows them to give it a large capacity while limiting its bulkiness. Additionally, this means that a smaller casing diameter is possible for each of the syringes forming the pump, and therefore fewer problems of tightness and less work on each of their respective pistons.

Advantageously, the pistons of all the syringes will be rigidly linked to each other such that they simultaneously carry out a single movement inside their respective casings.

Thus the electronic switch valves can be arranged in order that the respective unused syringes, although moved simultaneously to a used syringe, aspire then discharge any liquid at the same place, thus carrying out a neutral operation.

The syringe block can additionally comprise certain elements necessary for the functioning of the apparatus into which it is integrated, in particular an automatic analysis machine, these elements being advantageously fixed on the collector, which thus serves as a support. Among these elements can be at least a dilution chamber and/or a measurement chamber and/or an incubation chamber and/or a hydraulic circulation vessel and/or an optical bench. An element can also be a card carrying electronic circuits, said electronic circuits being used in the analysis where the said block is used in an automatic analysis machine. Thus, integrated into the syringe block, all these elements are close to one another, and in particular to the collector and the valves which distribute the different liquids.

The syringe block can also be placed in an air-conditioned enclosure. The liquids and the elements can be kept in ideal conditions for, respectively, their analysis and their use.

Additionally, the invention further comprises an automatic analysis machine, in particular an automatic blood analysis machine containing a syringe block according to the invention.

Other characteristics and advantages of the invention will emerge from the following description, relating to non-limiting examples.

In the attached drawings:

- figure 1 is a perspective view of a syringe block according to the invention;
- figure 2 is a part of a collector for a syringe block according to the invention;
- figure 3 is a block diagram of an automatic analysis machine according to the invention; and,
- figure 4 is a view of another embodiment of a syringe block.

Figure 1 represents a syringe block 1, provided to be integrated in an automatic blood analysis machine.

It comprises a set of six syringes 11-16 arranged in parallel, the casings of which are all formed in a single, more or less parallelepipedic casing piece 2. The casings are arranged vertically, such that a respective piston 21-26 (see figure 3) slides across their respective lower extremity, across a lower face of the casing 2.

In figure 1, the pistons are all rigidly fixed to a single clamp 9. The clamp is linked to a motor such that it can move all the pistons in a single movement M, here vertical translation, inside their respective casings. In figure 3, all the pistons are rigidly fixed to the clamp except for piston 21, which has two stops 17 for the clamp 9, one in each direction of translation according to movement M, thus defining dead travel for the piston 21 of the syringe 11.

The collector has a base 4 more or less in the form of a parallelepiped. The casing piece is fixed by an upper surface against a lower face of the base 4. It comprises several electronic switch valves 31 fixed to the upper face of the said parallelepiped. The collector also comprises, formed by moulding in the parallelepiped (see the piece in figure 2), a network 5,6 of ducts. This network comprises first, inside ducts 5, linking each syringe to at least one respective electronic switch valve. It also comprises second ducts 6, extending from the electronic switch valves towards, for example, containers for a sample to be analyzed, or towards containers for other liquids 41-43.

As illustrated in figure 2, the network is realized by moulding in the piece 8 forming part of the base 4. Another part, not shown, complementing the piece 8, completes the form of the ducts.

On its upper face, the collector also serves as a support for the elements of the automatic analysis machine, in particular an optical bench 51, a dilution and counting vessel 52, an optical and resistivity measurement vessel 53, and an electronic card 54, used for analysis.

Figure 3 will now be described in more detail, representing schematically the operation of an automatic analysis machine 10.

The syringes 11-16 include a syringe 11 assigned to the taking of an untreated blood sample, that is to say as presented initially to the automated machine, using a needle 61, and to the cleaning of the needle.

The syringes also include a syringe 12 for the handling of a diluting product 41, a syringe 13 for the handling of a lytic product 41, a syringe 14 for the handling of a cleaning product 42, and two syringes 15,16, coupled so as to form an air pump, specially assigned to the removal of waste 44, during or at the end of the analysis.

The untreated sample is introduced into the automated machine using the needle 61, then placed by this needle into a tank 62, serving in particular to dilute it. The syringes 15,16 forming the air pump, can in particular be used to take a sample from a receptacle 63, communicating direct with the tank 62, with a view to a counting. This sampling is carried out by creating a depression inside the receptacle 63 using the air pump.

Instead of a depression, the air pump can also be used to create an excessive pressure, for example to ensure the homogenization of a mixture.

The different positions of the electronic switch valves allow the user to carry out a task with one of the syringes while the others have a neutralized function, although the respective pistons of these other syringes are led to carry out a single movement M with the said one syringe.

The syringe block of the figure 4 is a lighter embodiment than the syringe block in figure 1. It comprises a collector 3, supporting six electronic switch valves 31 and five syringes 2, of which two syringes 15,16 form an air pump.

The invention is of course not limited to the examples which have just been described and numerous adjustments can be made to these examples without going beyond the scope of the invention.

In particular, the different parts and elements of the invention can differ in number and form from what has been described, as long as this does not affect their operation.

The first and/or second ducts can be reduced to simple holes, of sufficient thickness to cross a part of the collector linking, for example, an electronic switch valve and an associated syringe.

The first and/or second ducts can be realized by any other means other than machining or moulding. Instead of forming only a single layer of ducts between two complementary pieces, they can also form several layers of ducts placed one on top of another and separated two-by-two by an adapted piece, in which one of the two thus-separated layers can be realized.